WEST Search History

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DATE: Wednesday, August 11, 2004

Hide?	Set Name	Query	Hit Count
		DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=ADJ	
☐	L22	20010316	14
☐	L21	((control or end)adj3 (character or bit) adj3 (flag or indicator)) near8 header	20
☐	L20	((control or end)adj3 (character or bit) adj3 (flag or indicator))	547
☐	L19	20010316	2
☐	L18	(control adj3 (character or bit) adj3 indicator) near8 header	5
☐	L17	l10 and ((generate or create) near5 header)	1
☐	L16	l10 and (header near8 indicator)	1
☐	L15	L10 and (FC or (fibre adj2 channel))	0
☐	L14	L10 and(FC or (fibre adj2 channel))	0
☐	L13	L10 and l2	0
☐	L12	L10 and l1	0
☐	L11	L10 and (encapsulate or encapsulating or encapsulation or encapsulated)	0
☐	L10	20010316	94
☐	L9	(control adj2 (character or bit or byte)) near8 (data adj2 (character or bit or byte)) near8 (replace or replacing or change or changing or convert or converting)	111
☐	L8	(control adj2 (character or bit or byte)) near8 (data adj2 (character or bit or byte))	3256
☐	L7	L6 and l5	2
☐	L6	l4 and (encapsulate or encapsulating or encapsulation or encapsulated)	2
☐	L5	l4 and packet	6
☐	L4	L3 and (FC or (fibre adj2 channel))	28
☐	L3	20010316	35
☐	L2	primitive and (primitive adj3 sequence) and frame and (ordered adj3 set)	61
☐	L1	primitive and (primitive adj3 sequence) and frame	234

END OF SEARCH HISTORY

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DATE: Wednesday, August 11, 2004

Hide?	Set Name	Query	Hit Count
		DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=ADJ	
☐	L7	L6 and l5	2
☐	L6	l4 and (encapsulate or encapsulating or encapsulation or encapsulated)	2
☐	L5	l4 and packet	6
☐	L4	L3 and (FC or (fibre adj2 channel))	28
☐	L3	20010316	35
☐	L2	primitive and (primitive adj3 sequence) and frame and (ordered adj3 set)	61
☐	L1	primitive and (primitive adj3 sequence) and frame	234

END OF SEARCH HISTORY

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DATE: Wednesday, August 11, 2004

Hide?	Set Name	Query	Hit Count
		DB=USPT; PLUR=YES; OP=ADJ	
☐	L11	D28.5	1
☐	L10	K28.5	107
☐	L9	l6 and header and footer	0
☐	L8	L4 and (sequence near5 change)	1
☐	L7	L6 and (sequence near5 change)	1
☐	L6	L4 and (bandwidth)	59
☐	L5	L4 and (bandwidth near8 (conserve or conserving or conservation))	0
☐	L4	20010316	107
☐	L3	(fibre adj channel).ti.	123
☐	L2	fibre adj channel	3083
☐	L1	5638518.pn.	1

END OF SEARCH HISTORY

WEST Search History

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DATE: Tuesday, August 10, 2004

Hide?	Set Name	Query	Hit Count
		DB=PGPB,USPT,USOC,EPAB,JPAB,DWPI,TDBD; PLUR=YES; OP=ADJ	
☐	L17	20010316	7
☐	L16	LR and LRR and idle	123
☐	L15	L12 and l8	0
☐	L14	L12 and l1	0
☐	L13	L12 and l2	1
☐	L12	20010316	1156
☐	L11	(replace or replacing) near8 (control) near8 (data)	1510
☐	L10	L8 and l6	3
☐	L9	L8 and l7	1
☐	L8	l3 and (SAN or SANs)	47
☐	L7	L6 and l4	14
☐	L6	l3 and (control adj4 (command or character))	19
☐	L5	L4 and footer	0
☐	L4	L3 and header	75
☐	L3	20010316	236
☐	L2	((Fibre adj3 channel) or FC) same (encapsulate or encapsulating or encapsulated or encapsulation)	587
☐	L1	K28.5 and D28.5	7

END OF SEARCH HISTORY

L4: Entry 1 of 28 File: PGPB Nov 28, 2002

DOCUMENT-IDENTIFIER: US 20020176526 A1
TITLE: DATA COMMUNICATIONS BIT STREAM COMBINER/DECOMBINER

Abstract Paragraph:
A method and apparatus for multiplexing and demultiplexing multiple serial data streams provide double the data throughput on a single media channel, such as Fibre Channel (FC). A local clock provides both 0-degree phase and 180-degree phase signals of a clock signal at the same basic frequency as that of the incoming data, as well as a double-frequency clock signal. The first incoming data stream is routed to a first synchronizer unit, which receives a 0-degree phase signal of the local clock. The first synchronizer unit establishes and maintains synchronization of the first data stream with the 0-degree phase signal; it also tags the first data stream by replacing an original fill word with a special fill word. The second incoming data stream, on the other hand, is routed to a second synchronizer unit, which receives a 180-degree phase signal of the local clock. The second synchronizer unit establishes and maintains synchronization of the second data stream with the 180-degree phase signal. The synchronizer units maintain synchronization of the respective data streams by applying an elasticity function to the data streams. After synchronization to the local clock, the two resultant data streams are multiplexed by an interleaver at double the baud rate. At the end of the link, the combined bit streams are demultiplexed into separate bit streams by applying a phase locked loop to the received data, and generating a clock signal at one half of the incoming baud rate. A pattern detector scans the incoming multiplexed data for a fill words. The detector maintains the last received fill word in memory. Each special fill word is replaced with the original fill word. An output router is toggleable so that incoming bits in phase with the special fill words are routed to a first output. All other bits are routed to a second output.

Application Filing Date:
19990713

Summary of Invention Paragraph:
[0001] This invention relates to techniques for the transmitting serial data over a transmission medium. It also relates to methods for transmitting multiple bit streams on a single transmission medium. It further relates to Fibre Channel communications and communications protocol.

Summary of Invention Paragraph:
[0002] The Fibre Channel (FC) standard provides a general transport vehicle for Upper Level Protocols such as Intelligent Peripheral Interface (IPI) and Small Computer System Interface (SCSI) command sets, the High-Performance Parallel Interface (HIPPI) data framing, IP (Internet Protocol), IEEE 802.2, and others. Proprietary and other command sets may also use and share Fibre Channel, but such use is not defined as part of the Fibre Channel standard. Logically, the Fibre Channel is a bidirectional point-to-point serial data channel, structured for high-performance capability. Physically, the Fibre Channel can be an interconnection of multiple communication points, called N_Ports, interconnected by a switching network, called a fabric, an arbitrated loop, or a point-to-point link. The word fibre is a general term used to cover all physical media types supported by the

Fibre Channel, such as optical fiber, twisted pair, and coaxial cable.

Summary of Invention Paragraph:
[0003] The Fibre Channel standard specifies only a serial bit stream for transmission. Transfers between nodes over Fibre Channel occur between buffers. Information stored in a buffer (generally constructed from RAM) at a first node is sent from a transmitting port associated with that node, across a physical medium (i.e., the Fibre Channel), to a receiving port at a second node, and stored in a buffer at the second node. The basic unit of transfer for the contents of a buffer between two ports is the frame. A frame consists of a start-of-frame (SOF) word, a multi-word header, multiple data words, a cyclic redundancy check (CRC) word, and an end-of-frame (EOF) word.

Summary of Invention Paragraph:
[0004] Fibre Channel is structured as a set of hierarchical functions, each of which is described as a level. The lowest level, FC-0 (physical), has two components: interface and media. The media component defines the fibre, connectors and optical and electrical parameters for a variety of data rates. Coax and twisted pair versions are defined for limited distance applications. The interface component consists of transmitters, and receivers and their interfaces. The next level, FC-1 (transmission code and protocol), defines the transmission protocol which includes the serial encoding, decoding and error control. Level FC-2 (signaling protocol), which sits atop level FC-1, defines the signaling protocol which includes the frame structure and byte sequences. The next level, FC-3 (common services), defines a set of services which are common across multiple ports of a node. The highest level in the Fibre Channel standards set, FC-4 (mapping), defines the mapping between the lower levels of the Fibre Channel and the IPI and SCSI command sets, the HIPPI data framing, IP and other Upper Level Protocols (ULPs).

Summary of Invention Paragraph:
[0005] A buffer can be thought of as an ordered set of bytes numbered from 0 to n. Neither the actual length of a buffer nor the technology used to store the bytes are defined by the Fibre Channel standard. Stored bytes are transmitted in the order of increasing displacement (i.e., from low address to high address), starting with the first.

Summary of Invention Paragraph:
[0006] Fibre Channel does not provide for error correction of transmitted information. Instead, it relies solely on error detection and retransmission of inaccurately received information. Consequently, information stored in the buffer at the first node is not overwritten until it is determined that the information was accurately stored in the second node. The observed bit error rate (BER) over optical media seems to be about 1 error in 10E16 to 10E24 bits, which is well within the maximum 1E12 requirement of the Fibre Channel specification. With a BER of 1 error in 10E16 bits, and a Fibre Channel standard transmission rate of 1.0625 gigabaud/second, one error is expected on a single fibre of a link about once during each 1089 days. In order to provide for both the ordered sending of information bytes over the Fibre Channel and for the detection of errors, transmitted information bytes are encoded. Fibre Channel transmits information using an adaptive 8B/10B code. Code rules require that each 8-bit byte of data be transformed into a 10-bit Data Transmission Character. Two types of Transmission Characters are defined: Data and Special. The Special Transmission Characters are used to specify the maximum run length of a transmission and to provide word alignment.

Summary of Invention Paragraph:
[0007] The 8B/10B encoding scheme in Fibre Channel utilizes "running disparity" to detect most errors in received transmission characters. Cyclic redundancy checks (CRC) are used to detect errors which are undetected by running disparity. Running disparity is a requirement that the transmission code have a balance of ones and

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L4: Entry 3 of 28 File: PGPB Jun 7, 2001

DOCUMENT-IDENTIFIER: US 20010002901 A1
TITLE: Sanitizing fibre channel frames

Abstract Paragraph:
Methods and apparatus for implementing a technique for sanitizing data frames in a network loop. In a preferred implementation, a port for connecting a node to a network loop includes a detect element, where the detect element monitors data from the node and sets an error flag when invalid data is received at the port; a frame termination generator, which generates frame termination primitives; a buffer data generator, which generates buffer data; a switching element having a control input, an output, and a plurality of data inputs, where each of an output of the node, the upstream node, the frame termination generator, and the buffer data generator is connected to a corresponding data input; and a control element connected to the detect element and the control input of the switching element, where the control element selects, according to the error flag, one of the data inputs of the switching element to connect to the output of the switching element to be output by the port to a downstream node, and the control element terminates a current data frame by selecting the data input corresponding to the frame termination generator when the error flag indicates the current data frame includes invalid data.

Application Filing Date:
20010130

Summary of Invention Paragraph:
[0003] Features of both channels and networks have been incorporated into a new network standard known as "Fibre Channel". Fibre Channel systems combine the speed and reliability of channels with the flexibility and connectivity of networks. Fibre Channel products currently can run at very high data rates, such as 1062 Mbps. These speeds are sufficient to handle quite demanding applications, such as uncompressed, full motion, high-quality video. ANSI specifications, such as X3.230-1994, define the Fibre Channel network. This specification distributes Fibre Channel functions among five layers. The five functional layers of the Fibre Channel are: FC-0-the physical media layer; FC-1-the coding and encoding layer; FC-2-the actual transport mechanism, including the framing protocol and flow control between nodes; FC-3-the common services layer; and FC-4-the upper layer protocol.

Summary of Invention Paragraph:
[0004] There are generally three ways to deploy a Fibre Channel network: simple point-to-point connections; arbitrated loops; and switched fabrics. The simplest topology is the point-to-point configuration, which simply connects any two Fibre Channel systems directly.

Summary of Invention Paragraph:
[0005] Arbitrated loops are Fibre Channel ring connections that provide shared access to bandwidth via arbitration. Switched Fibre Channel networks, called "fabrics", are a form of cross-point switching.

Summary of Invention Paragraph:
[0006] Conventional Fibre Channel Arbitrated Loop ("FC-AL") protocols provide for

loop finctionality in the interconnection of devices or loop segments through node ports. However, direct interconnection of node ports is problematic in that a failure at one node port in a loop typically causes the failure of the entire loop. This difficulty is overcome in conventional Fibre Channel technology through the use of hubs. Hubs include a number of hub ports interconnected in a loop topology. Node ports are connected to hub ports, forming a star topology with the hub at the center. Hub ports which are not connected to node ports or which are connected to failed node ports are bypassed. In this way, the loop is maintained despite removal or failure of node ports.

Summary of Invention Paragraph:
[0007] More particularly, an FC-AL network is typically composed of two or more node ports linked together in a loop configuration forming a single data path. Such a configuration of a node port-to-node port loop is shown in FIG. 1. In FIG. 1, six node ports 102, 104, 106, 108, 110, 112 are linked together by data channels 114, 116, 118, 120, 122, 124. In this way, a loop is created with a datapath from node port 102 to node port 104 through data channel 114 then from node port 104 to node port 106 through data channel 116, and so on to node port 102 through data channel 124.

Summary of Invention Paragraph:
[0009] A conventional technique to avoid broken datapaths in a node port-to-node port loop introduces a hub within a loop. A hub creates a physical configuration of node ports in a star pattern, but the virtual operation of the node ports continues in a loop pattern. The connection process (i e., sending data between node ports) and interaction with the hubs is effectively transparent to the node ports connected to the hub, which perceive the relationship as a standard Fibre Channel arbitrated loop configuration.

Summary of Invention Paragraph:
[0012] The content of a datastream of an FC-AL network is defined by FC-AL protocols. Characters are constantly moving through the loop from one port to the next. These characters may be actual data or loop control signals. Loop control signals are always present in the datastream except when a data frame is being sent from a source node port to a destination node port. Under FC-AL protocols, the loop control signals are ordered sets, including primitive signals and primitive sequences. Ordered sets typically begin with a special character indicating the beginning of an ordered set, such as K28.5.

Summary of Invention Paragraph:
[0013] A data frame includes a series of one or more data words preceded by a frame initiation primitive and followed by a frame termination primitive. An FC-AL data frame includes an uninterrupted stream of data preceded by a special ordered set called a Start Of Frame ("SOF") and succeeded by a special ordered set called an End Of Frame ("EOF"). An End Of Frame Abort ("EOFA") is a special type of EOF ordered set, for aborting a frame. An interframe gap occurs after a frame termination primitive and before the next frame initiation primitive. Under FC-AL protocols, an interframe gap is defined to include six ordered sets, by default.

Summary of Invention Paragraph:
[0014] A datastream of encoded characters ideally always has a valid "running disparity". The encoded characters are defined according to a conventional 8 B/10 B encoding scheme, defined in Fibre Channel protocols. The running disparity at the end of a character in the datastream is the difference between the number of 1's and 0's in the bit encoding of the character. A character with more 1's than 0's has a positive running disparity. A character with more 0's than 1's has a negative running disparity. A character with an equal number of 1's and 0's has a neutral running disparity. An encoder transmits a positive, negative, or neutral disparity encoded character. A neutral character does not affect the running disparity of the datastream. A positive character changes the running disparity from negative to

L4: Entry 19 of 28 File: USPT Dec 5, 2000

DOCUMENT-IDENTIFIER: US 6158014 A
TITLE: Automatic detection of 8B/10B data rates

Application Filing Date (1):
19981202

Brief Summary Text (5):
Features of both channels and networks have been incorporated into a new network standard known as "Fibre Channel". Fibre Channel systems combine the speed and reliability of channels with the flexibility and connectivity of networks. Fibre Channel products currently can run at very high data rates, such as 1062 Mbps. These speeds are sufficient to handle quite demanding applications, such as uncompressed, full motion, high-quality video. ANSI specifications, such as X3.230-1994, define the Fibre Channel network. This specification distributes Fibre Channel functions among five layers. The five functional layers of the Fibre Channel are: FC-0--the physical media layer; FC-1--the coding and encoding layer; FC-2--the actual transport mechanism, including the framing protocol and flow control between nodes; FC-3--the common services layer; and FC-4--the upper layer protocol.

Brief Summary Text (6):
There are generally three ways to deploy a Fibre Channel network: simple point-to-point connections; arbitrated loops; and switched fabrics. The simplest topology is the point-to-point configuration, which simply connects any two Fibre Channel systems directly. Arbitrated loops are Fibre Channel ring connections that provide shared access to bandwidth via arbitration. Switched Fibre Channel networks, called "fabrics", are a form of cross-point switching.

Brief Summary Text (7):
Connections between devices in a Fibre Channel network are referred to as links. Data is transmitted across links between devices in a serial bitstream. The serial bitstream is encoded using an eight-bit/ten-bit ("8B/10B") encoding scheme. The bitstream includes a series of 10 bit characters. The devices typically deserialize and decode the incoming 10 bit characters to 8 bit characters and then serialize and encode outgoing data back to 10 bit characters. Accordingly, each Fibre Channel protocol device includes a "serdes" device for serializing and deserializing data to and from the device's link. For example, when a device outputs data onto a link, the device's serdes serializes the data from the device into a serial bitstream. When receiving data from a link, the device's serdes deserializes the serial bitstream on the link into ten-bit characters. These characters are then gathered into four character words.

Brief Summary Text (8):
When a Fibre Channel node port is properly connected to an active Fibre Channel link, the node port receives a stream of data words and Fibre Channel ordered set words (e.g., primitive signals, primitive sequences, and frame delimiters). Each ordered set word includes four ten-bit characters. The first ten-bit character is defined to be a special character known as the "K28.5" character. For all primitive signals and primitive sequences, the K28.5 ten-bit character is a "K28.5+"

character. The K28.5+ character is encoded as 0.times.0FA, i.e., 0011111010. The first seven bits of this character correspond to a pattern referred to as the "comma pattern", 0011111. The deserializer within a commodity serdes device uses the comma pattern to synchronize the deserialization process to ten-bit character boundaries in the bitstream.

Brief Summary Text (13):
In a Fibre Channel implementation, a Fibre Channel node port for connecting a Fibre Channel protocol device to a Fibre Channel network includes a data input for receiving a bitstream from a Fibre Channel network, where the bitstream has a data rate; a deserializer connected to the data input, where the deserializer deserializes the bitstream received via the data input, generating 10-bit data characters, and where the deserializer is capable of operating at more than one clock speed; and a Fibre Channel protocol device connected to the deserializer, where the Fibre Channel protocol device receives the data characters from the deserializer and sends clock control signals to the deserializer to set the clock speed of the deserializer to match the data rate of the bitstream.

Brief Summary Text (16):
The technique of the present invention provides several advantages. By allowing the Fibre Channel node port to positively identify the transmission data rate of the received serial bitstream, determination by trial and error is avoided. The node port is also able to distinguish between a non-functional connection and an incorrectly configured link connection by checking the pattern of the received bitstream (i.e., typically, a non-functional connection does not generate a recognizable pattern). By recognizing certain patterns in the deserialized data stream, the node port can quickly determine the data rate of the received serial bitstream and provide a definite indication to the controlling protocol of the data rate of the transmitter of the link data. Because the node port can set the deserializer clock speed to match the determined data rate of the serial bitstream, Fibre Channel devices which can operate at more than one data rate can be deployed and such devices are backwards compatible with the currently installed base Fibre Channel networks that typically run at a link rate of 1.0625 giga-bits per second ("Gbps").

Drawing Description Text (2):
FIG. 1 shows a Fibre Channel node port according to the invention.

Detailed Description Text (2):
The invention provides methods and apparatus for implementing a technique for determining a data rate of a serial bitstream using pattern recognition and for matching a clock speed of a deserializer to that data rate. The invention is explained below in the context of a Fibre Channel network as an illustration of a preferred implementation. However, the invention may have applicability to networks with similar characteristics to Fibre Channel networks. For example, the invention is applicable to other networks which use an 8B/10B encoding scheme, such as Gigabit ethernet and NGIO.

Detailed Description Text (4):
FIG. 1 shows a Fibre Channel implementation of a Fibre Channel node port 100 according to the invention. The Fibre Channel node port 100 includes a serializer/deserializer ("serdes") device 105 and a connection to a Fibre Channel protocol device 110 (i.e., a network device which operates in compliance with Fibre Channel protocols.) The serdes device 105 includes a deserializer 115. The deserializer 115 receives a serial bitstream of data from a connected network. The deserializer 115 synchronizes to character boundaries in the serial bitstream and generates multiple bit characters, as described below. In a Fibre Channel implementation, the deserializer generates ten-bit characters. The deserializer 115 supplies the characters to pattern recognition logic 120 in the Fibre Channel protocol device 110. The pattern recognition logic 120 determines the data rate of

the serial bitstream by recognizing predefined patterns in the characters received from the deserializer 115, as described below. The pattern recognition logic 120 sends control signals to a deserializer control circuit 125 indicating the determination of the data rate of the serial bitstream. FIG. 1 shows an implementation where the node port 100 is capable of operating at two speeds, "2.times." and "1.times." (e.g., approximately 2 Gbps and 1 Gpbs, respectively). In alternative implementations, the node port can be designed to accommodate more speeds and at different ratios than a factor of two. When the pattern recognition logic 120 recognizes a first pattern in the characters received from the deserializer 115, the pattern recognition logic 120 sends a first speed control signal (i.e., 2.times.) to the deserializer control circuit 125. When the pattern recognition logic 120 recognizes a second pattern in the characters received from the deserializer 115, the pattern recognition logic sends a second speed control signal (i.e., 1.times.) to the deserializer control circuit 125.

Detailed Description Text (6):
In an alternative implementation, the Fibre Channel protocol device 110 does not include a deserializer control circuit 125. In such an implementation, the Fibre Channel protocol device 110 receives an output signal from the pattern recognition logic 120 indicating the data rate of the serial bitstream. The Fibre Channel protocol device 110 uses the signal as appropriate according to the application.

Detailed Description Text (8):
In an example of a Fibre Channel implementation, assume the deserializer receives the following bitstream:

Detailed Description Text (13):
FIG. 2 shows a process 200 of synchronizing the deserializer to the character boundaries of the serial bitstream. The Fibre Channel protocol device sets the clock speed of the deserializer to a maximum speed (e.g., 2.times.) (step 205). The deserializer receives a stream of bits as a serial bitstream from the connected network (step 210). The deserializer examines the incoming bitstream to find a predefined pattern (step 215). This pattern is predefined to indicate a special character according to the network protocol of the network. In a Fibre Channel implementation this pattern is the comma pattern. The comma pattern is unique and only used to indicate a K28.5 character at the beginning of an ordered set word. After the deserializer has found the predefined pattern in the bitstream, the deserializer outputs multiple bit characters using the predefined pattern as a starting point (step 220). In a Fibre Channel implementation, the comma pattern is a seven bit pattern. The next three bits in the bitstream complete the character including the comma pattern. Accordingly, the deserializer can conclude that the comma pattern plus the succeeding three bits form a proper ten-bit character. The deserializer passes these ten bits to the Fibre Channel protocol device as a character. The deserializer passes succeeding groups of ten bits from the serial bitstream to the Fibre Channel protocol device as succeeding characters and so is synchronized to ten-bit character boundaries in the bitstream.

Detailed Description Text (14):
For a node port capable of running at multiple speeds, such as approximately 1 Gbps (1.times.) and 2 Gbps (2.times.), the node port can quickly determine the data rate of the received serial bitstream by configuring the deserializer to the maximum clock rate (i.e., 2.times.) and then waiting to see what speed of K28.5+ character is detected by the pattern recognition logic. If the 2.times. speed K28.5+ character is detected, the deserializer is correctly configured, matching the data rate of the bitstream, and so the Fibre Channel protocol device does not change the configuration of the deserializer. If the 1.times. speed K28.5+ character is detected, the Fibre Channel protocol device configures the deserializer to run at the lower 1.times. clock rate before attempting to establish communication on the link. If no K28.5+ characters are detected at any available speed, the pattern recognition logic determines that the link is effectively nonfunctional.

Detailed Description Text (15):
FIG. 3 shows a process 300 of setting the clock speed of the deserializer to match the data rate of the serial bitstream. FIG. 3 describes this process in terms of a Fibre Channel implementation. However, the details described below, such as the number of bits in a character or the content of the patterns used to recognize the data rate of the serial bitstream, can be changed to accommodate alternative network protocols and applications. After the deserializer has synchronized to both the bit and character boundaries of the serial bitstream, the pattern recognition logic looks for a ten-bit character where the upper seven bits are the seven bit comma pattern (step 305). The pattern recognition logic then checks the lower three bits of that character (step 310). If these three bits are 010, then this character is a K28.5+ character (step 315). The data rate of the received serial bitstream is the same as the clock speed of the deserializer, and the Fibre Channel protocol device does not need to adjust the clock speed of the deserializer (step 320). The pattern recognition logic recognizes that the deserializer and the serial bitstream are at the same rate because the deserializer generated a ten-bit character corresponding to the ten-bit code for the K28.5+ character.

Other Reference Publication (1):
Fiber Channel Tutorial, http://www.fibrechannel.com/technology/tutorial.htm.

Other Reference Publication (2):
Fibre Channel Overview, http://www.cern.ch/HSI/fcs/spec/overview.htm.

Other Reference Publication (3):
Fibre Channel Glossary, http://www.iol.unh.edu/training/fc/fcglossary.html.

CLAIMS:

2. The port of claim 1, where the network is a Fibre Channel network.

7. A node port for connecting a Fibre Channel protocol device to a Fibre Channel network, the node port comprising:

(a) a data input for receiving a bitstream from a Fibre Channel network, where the bitstream has a data rate;

(b) a deserializer connected to the data input, where the deserializer deserializes the bitstream received via the data input, generating 10-bit data characters, and where the deserializer is capable of operating at more than one clock speed; and

(c) a Fibre Channel protocol device connected to the deserializer, where the Fibre Channel protocol device receives the data characters from the deserializer and sends clock control signals to the deserializer to set the clock speed of the deserializer to match the data rate of the bitstream.

8. The port of claim 7, where the Fibre Channel protocol device determines the data rate of the bitstream by recognizing patterns in the data characters generated by the deserializer.

9. The port of claim 7, where the Fibre Channel protocol device includes:

(a) pattern recognition logic for receiving the data characters and determining which clock speed corresponds to the data rate of the bitstream, generating control signals indicating the data rate of the bitstream; and

(b) a deserializer control circuit connected to the pattern recognition logic and to the deserializer, where the deserializer control circuit receives the control signals from the deserializer control circuit, and where the deserializer control

circuit sends clock control signals to the deserializer to set the clock speed of the deserializer according to the control signals from the deserializer control circuit.

15. The method of claim 12, where the bitstream is in a Fibre Channel network.

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L7: Entry 2 of 2 File: USPT Nov 9, 1993

DOCUMENT-IDENTIFIER: US 5260933 A
TITLE: Acknowledgement protocol for serial data network with out-of-order delivery

Abstract Text (1):
A system and method for controlling the transmission of frames or packets of data in a serial network which allows out-of-order delivery. The data frames transmitted by the initiator node to the recipient node include frame serial number or sequence count information. Acknowledgment frames, transmitted by the recipient node to indicate delivery of the data frame or packet, include matching serial number or sequence count information. According to one form of the present invention, the initiator node and recipient node include resources which relate the serial number or sequence count information, resources which include control information in the acknowledgment frame, and resources which determine the transmit status of all acknowledgment frames prior to that specified by serial number or sequence count in the acknowledgment frame. The status information is used at the initiator node to update the status of any data frames whose acknowledgment has not been received as a consequence of an out-of-order delivery to the recipient, a delay in processing by the recipient, a delay of the acknowledgment frame in the transmission back to the initiator node, or a complete loss of the acknowledgment frame.

Application Filing Date (1):
19920515

Brief Summary Text (2):
The present invention relates generally to systems and methods for transmitting frames or packets of information through a communication network. More particularly, the invention is directed to systems and methods for transmitting frames or packets of information in serial networks which utilize acknowledgments and allow out-of-order delivery of the frames or packets.

Brief Summary Text (3):
Numerous serial data communication protocols exist for transmitting frames or packets of information from an initiator (source) node to a recipient (destination) node in local and wide area networks. To ensure the consistency of the data at the receiving end, conventional practice involves the use of an acknowledgment transmission from the recipient node back to the initiator node upon acceptance of the information in the frame by the recipient. Though acknowledgment signals are not used as a routine in voice communication environments, comprehensive acknowledgment usage is mandatory for integrity in digital data transmissions.

Brief Summary Text (4):
A commercially available example of a serial network is the fibre optical serial channel used with the RISC System/6000 workstation product sold by IBM Corporation. Another example of such a system is defined by the Fibre Channel Standard (FCS) being developed by the American National Standards Institute (ANSI) X3T9.3 Task Group. The technology is documented in the Fibre Channel Physical and Signaling Interface (FC.sub.-- PH) Rev. 2.2 document available from Global Engineering, 2805 McGaw Street, Irvine, Calif. 92714.

Brief Summary Text (5):
A fundamental weakness of the technologies in present use and proposed in such standards arises from the need of an acknowledgment frame for each data frame transmitted by the initiator. Without specific network protocol constraints, out-of-order delivery of data frames is the serial packet network norm of operation. Even if delivery of data frames or packets follows the order transmitted, there remains the possibility that the processing of the frames by the recipient to confirm adequacy of the information in the frames may differ between successive frames. The timing of the acknowledgment transmissions would follow accordingly. Similarly, the acknowledgment frame is also subject to the out-of-order delivery to the initiator as a consequence of a busy network. In some circumstances the acknowledgment frame is completely lost as a consequence of an error in the network. Also possible are volitional deletions of acknowledgments by the network as a consequence of congestion or priority conditions. On the other hand, the rate of network communication is reduced significantly if the protocol requires that the data frames wait for an acknowledgment of each preceding data transmission, or that channels of the network be monopolized to ensure consistency of the data transmission and acknowledgment information.

Brief Summary Text (6):
In addition to acknowledgments that are lost, and as a consequence initiate error procedures within the network, standards of the type noted earlier define networks in which one or more acknowledgment frames have the misfortune of being transmitted and retransmitted into a then busy network. In each case the acknowledgment frames are returned to recipient node for later retransmission while the initiator node waits for the acknowledgment specific to the data frame.

Brief Summary Text (7):
Given the difficulty of handling out-of-order or lost acknowledgments, the prevailing design practice has been to require an ordered transmission in which an acknowledgment is expected for each data frame transmitted. Though the standards contemplate the use of time windows for delayed acknowledgment, the approach has proven to be relatively slow and particularly susceptible to further degradation as network congestion increases.

Brief Summary Text (9):
The present invention provides systems and methods of practice which facilitate out-of-order transmission of data by the initiator, and acknowledgment information by the recipient, in frames or packets over a multi-node serial network. The architecture and protocol are implemented by system and method resources at the initiator and recipient ends of the communication path. The resources relate data frame serial number or sequence count as defined at the initiator node to corresponding serial number or sequence count in the acknowledgment information transmitted from the recipient node. The invention is characterized by its provision for controller parameter information in the acknowledgment frame, such information representing that all acknowledgments for data frames prior to the serial number or sequence count of the acknowledgment were transmitted by the recipient node. In a preferred implementation, the acknowledgment frame includes within the frame header parameter field a control bit to indicate by its state the transmission status of all preceding acknowledgment frames.

Drawing Description Text (3):
FIG. 2 is a schematic block diagram of a fibre channel standard communication hierarchy.

Drawing Description Text (4):
FIG. 3 is a schematic block diagram of a FC-2 frame format.

Drawing Description Text (5):
FIG. 4 is a schematic block diagram of a frame header format.

L7: Entry 1 of 2 File: USPT Apr 8, 1997

DOCUMENT-IDENTIFIER: US 5619497 A
TITLE: Method and apparatus for reordering frames

Abstract Text (1):
A method and apparatus for coupling a plurality of channels of a communications network to a node. The node includes a plurality of ports, each adapted for connection to a corresponding channel and a system interface adapted for connection to a plurality of node clients in the form of host computers, peripheral devices, network interfaces, etc. The node includes a receiver and transmitter dedicated to each port and common circuitry for controlling and processing frames received and/or transmitted by the plurality of ports. A frame prioritization circuit forwards frames received by a selected port to a frame handler for processing and a frame routing circuit routes frames processed by the frame handler to at least one of the ports associated with at least one destination node. The node further includes a frame header buffer associated with each port for temporarily storing the header of each frame received by the respective port prior to forwarding of the header to the frame handler.

Application Filing Date (1):
19960315

Parent Case Text (1):
This application is a continuation of application Ser. No. 08/433,086, filed May 3, 1995 entitled: DYNAMIC NODE SHARING APPARATUS AND TECHNIQUES which is a continuation-in-part application of U.S. Ser. No. 08/363,392, filed Dec. 22, 1994 entitled: METHOD AND APPARATUS FOR REORDERING FRAMES.

Brief Summary Text (2):
This invention relates generally to communications networks and more particularly, to apparatus and techniques for processing frames at a node having a plurality of ports.

Brief Summary Text (4):
Switch networks, or fabrics, for transmitting packets between two or more nodes are known. Typically, a packet, sometimes referred to alternatively as a sequence, includes multiple frames, with each frame including a header and a payload, such as data. Switch fabrics include a plurality of switches arranged to permit transmission of frames over different paths, or channels. Each node has a port adapted for connection to a respective channel. One illustrative type of switch fabric is Fibre Channel, in which the nodes connected to the fabric are referred to as N.sub.-- Ports.

Brief Summary Text (5):
Illustrative nodes are connected to various types of systems or node clients, such as work stations, data storage devices, or arrays, and network interfaces. A network interface node client is adapted for connection to a network, such as a local area network, thereby permitting communication between other nodes connected to the switch fabric and nodes connected to the network. Although generally a node is capable of both transmitting and receiving packets, in the transmission of a

given packet, the node transmitting the packet is referred to hereinafter as the transmitting, or source node and the node receiving the packet is referred to hereinafter as the receiving, or destination node.

Brief Summary Text (6):
Each node includes circuitry for receiving frames from a source node over the respective channel, processing received frames, and transmitting processed frames to one or more destination nodes over the respective channel. Thus, each node has dedicated frame receiving, processing, and transmitting circuitry associated therewith.

Brief Summary Text (7):
Various techniques are employed for optimizing transmission of frames through a fabric in order to minimize congestion on a particular path and thus, to reduce transmission time. However, such transmission optimization may result in frames of a given packet arriving at the destination node in an order different from the order in which the frames are arranged in the packet prior to transmission.

Brief Summary Text (8):
One technique for reordering frames received at a node out of order is to generate and store a memory entry corresponding to each of the received frames, including a "sequence count" identifying the sequential position of the frame within its associated packet. Once all of the frames of a packet are received, a processor executes a program to sort the memory entries by sequence count. However, since the memory includes as many entries as there are frames in the packet, this technique tends to be inefficient in terms of both memory requirement for storing the entries and processing time for sorting the entries.

Brief Summary Text (10):
In accordance with the invention, a receive node is provided with a port for reordering frames of a packet received at the port out of order in a manner that requires less memory space and processing time than heretofore required. Note that in the case where a node has only one port associated therewith, the terms "node" and "port" are used interchangeably. The port includes a frame manager which receives frames and generates a reassembly table in an associated memory including only entries corresponding to frames received out of sequential order with respect to a previously received frame (and a last entry indicating that the last frame of the respective packet has been received). In one embodiment, each such memory entry includes a sequence count, identifying the previously received frame, a pointer to a location in memory at which data associated with a set of one or more previously, consecutively received frames are stored, and a data length value representing the length of data associated with the set of frames.

Brief Summary Text (11):
The reassembly table entries are processed to reorder the frames of the received packet. More particularly, the port is in communication with a system which includes a processor for processing entries of the reassembly table in ascending sequence count order to reorder the packet frames. Illustrative systems include a host computer, a disk array, and a network.

Brief Summary Text (12):
In one embodiment, the receiving node processes frames of multiple packets simultaneously and the frame manager generates multiple reassembly tables, each one corresponding to a processed packet. To this end, a context is stored for each processed packet and includes fields used to generate memory entries for non-consecutively received frames of the respective packet.

Brief Summary Text (13):
A method for reordering a plurality of frames of a packet received by a node in non-consecutive order includes the steps of receiving a frame, comparing the

L22: Entry 2 of 14 File: USPT Feb 3, 2004

DOCUMENT-IDENTIFIER: US 6687766 B1
TITLE: Method and apparatus for a fibre channel control unit to execute search commands locally

Application Filing Date (1):
20000112

Detailed Description Text (314):
Device-level controls are used to modify or control the execution of an I/O operation, or to place the control unit and device in a known state. Most device-level controls are specified by combinations of bits in the device-header flag field and the IUI field in the IU header. For command and Control IUs, device-level controls are also specified in the command or control DIB. For other IU types, device-level controls are specified only by the device-header flag field and IUI field.

L22: Entry 13 of 14 File: USPT Oct 26, 1999

DOCUMENT-IDENTIFIER: US 5974496 A
TITLE: System for transferring diverse data objects between a mass storage device and a network via an internal bus on a network card

Application Filing Date (1):
19970102

Detailed Description Text (43):
The stream protocol 130 is an ATM protocol controlling the transfer of Packet Data Units (PDUs) over the ATM network. A PDU is a packet of data as large as 64 KB. The ATM cells contain PDUs that have header information and trailer information. The header includes an end of packet and end of cell bit flags. The last cell contains an error checking CRC (checksum). The checksum is used by the ATM chipset to determine if an error occurs during transmission of that PDU. If an error condition occurs, it is the responsibility of the stream protocol 130 to notify the upper protocol layers that a transmission error has occurred. The SAM card must decide what QoS parameters to use for that PDU and decide whether to (a) discard the PDU, (b) transmit the bad PDU, or (c) retransmit the PDU.